

reputed weight of trains hauled without quoting the average speed? Surely the one can be of little service without the other. Continental locomotive practice is well represented in the types in use on the St. Gothard railway. Of peculiar types of locomotives perhaps the six-coupled double bogie Fairlie engine is a good example. This engine, designed by Sir Alexander M. Rendel for the Mexican Railway Company, is stated to be able to haul a train weight of 3600 tons on the level. The engine when fully charged carries 2850 gallons of water, and has 300 cubic feet of room for coal, and weighs 92½ tons. On regular duty the engines run on a section of road which, for a length of fourteen miles, has many gradients of 1 in 25, with curves of 350 feet radius. More recent Fairlie engines supplied to this company weigh 93 tons 16 cwt. in running order, and are reported to do their work admirably.

We now come to the description of the different types of compound locomotives in use. These are practically all included in the Webb and Worsdell types in use in this country. Of the Webb type we find the Dreadnought class, and, in the appendix, the Greater Britain, thoroughly described and well illustrated.

At the present time the London and North-Western Railway Company have eighty-three compound locomotives of Mr. Webb's design at work, the total mileage of which since 1882 up to the end of December, 1892, was 22,854,037 miles, with an average consumption of 35·1 lbs. of coal per mile. This includes not only the fuel consumed in actually working the train, but also 1·2 lbs. used in raising steam and all fuel consumed whilst the engine is standing or shunting. The description of the Worsdell type of compound is equally clear, and is well illustrated by the Great Eastern and North Eastern locomotives. Why, however, are the Worsdell intercepting and starting valves alone described and illustrated? when this type of valve is seldom if ever used outside the North-Eastern Railway, the Worsdell Von Borries, Lapage, disc automatic valve being generally adopted in its place. Sixty Worsdell compound goods engines of the Mogul type have recently been sent to India, the cylinders being respectively 20 inches and 28 inches in diameter, stroke 26 inches, and the coupled wheels 5 feet 1½ inches in diameter. These engines and tenders weigh about 95 tons in running conditions.

In the addenda to the second volume there is some interesting information in reference to the construction of American locomotives and boilers, and details are freely illustrated. Following this is a description of the Vaucrain compound locomotive as made by the Baldwin locomotive works. Then comes a short description of the Westinghouse brake—a very good break no doubt; but why should not the Vacuum brake find a place in the volume?

These volumes cannot of course be appreciated without careful study. They are a perfect mine of information, partly original, partly derived from contributions to the proceedings of various technical institutions and societies. The illustrations are excellent, and the typography remarkably clear. The work should be welcomed, both by the student and the engineer, as the best text-book on the steam engine and boiler yet published.

N. J. LOCKYER.

A LIFE OF LOUIS AGASSIZ.

Louis Agassiz: his Life and Work. By Charles Frederick Holder, LL.D., &c. (Leaders in Science.) (G. Putnam's Sons, New York and London.)

WITHOUT a Life of Louis Agassiz a series of histories of leaders in science would be incomplete. Fortunately materials are not lacking, for in addition to the "Life and Correspondence" edited by his widow, there are numerous sketches and accounts of particular aspects of the man. The present volume tells the main incidents of his life and work, pleasantly and succinctly, and presents us with a clear outline of a remarkable personality. The book is well printed and the illustrations are not few. Some are good, others are not specially connected with the text, two are failures. Both relate to Switzerland. One is 'a sensational picture of Agassiz' "descent into the heart of a glacier," where he is being lowered down into a crevasse, while the text clearly shows that he descended a *moulin*. The other represents "Agassiz on the pinnacle of the Jungfrau." We think that this must be a studio composition, for the "pinnacle" is not very like what we have seen, and the topography of the view is incomprehensible.

Agassiz was a sturdy Swiss lad, uniting, as became a Neuchâtelais, something of French versatility with German tenacity of purpose; a close and keen observer delighting in every aspect of nature, happily neither "crammed" nor forced as a boy. When only twelve years old he was an omnivorous collector, and was more than this, a close student of his treasures.

Intended for commerce, he prevailed upon his parents to let him attend a course of classes at the University of Lausanne, then to proceed to Heidelberg and Munich as a student of medicine. At the age of twenty-three he had obtained the degree of doctor in that faculty as well as in philosophy. By this time, however, he had determined to devote himself to science, having already made his mark by his work on fresh-water fishes. After some stay in Paris a professorship was ultimately created for him at Neuchâtel, which he held until a visit to America ended in his accepting a post at Cambridge, Massachusetts, and settling down in the United States. But before leaving his native land he had become famous also by his studies of glaciers; still it was in the New World that the most important part of his life's work was done. Apart from the immense impulse which he gave to the progress of science in the United States, his explorations along the coast of Florida, in Brazil, on both coasts of South America, all supplied abundant material for study, which was worked up with unflagging industry.

The book, in short, is a marvellous record of work accomplished. We read in it of incessant labours in the lecture-room, the laboratory, and the field, yet the list of his books and scientific papers appended to this volume is perfectly appalling. Of the former there are thirty-nine, large and small; the list of the latter occupies twenty-two and a-half pages, each containing about ten entries, on the average. But this incessant activity, mental and physical, wore out even the sturdy Switzer, careful as he had always been in exercising the body. Cuvier's last words

to him, "Be careful, and remember that work kills," had been, perhaps of necessity, neglected. The day after they were spoken the great naturalist had been stricken to death by paralysis. They were equally prophetic in the case of Agassiz, for by his sixty-seventh year even his vigorous constitution was worn out.

Agassiz was a born teacher. As one of his admirers says, "His greatest work in science was his influence upon other men." Surely this is one of the best of epitaphs. This memoir contains some pithy sayings worth remembering in our generation. These are a few samples—"It is a false idea to suppose that anybody is competent to learn or to teach anything;" "The mind is made strong not through much learning but by the thorough possession of something;" "Learn to read the book of Nature for yourself;" "Train your pupils to be observers;" "It is better to have a few forms well known than to teach a little about many hundred species;" "The study of Nature is an intercourse with the highest mind." A remark, also of his, has a lesson for this age of many books, when he said, commenting on his early difficulties in obtaining them, that "he believed it had been really an advantage, for it prevented him from relying too much on them, their absence forcing him to investigate for himself."

Dr. Holder compares the influence of Agassiz in America with that of Darwin in England. It was in many respects very different, as were the men; yet they had much in common: the same intense love of nature, the same thirst for knowledge, the same indomitable energy in the pursuit of it. They were alike in being seriously hampered: Agassiz by poverty, at any rate in the earlier part of his life, for many a time his mind had to be fed at the expense of his body; Darwin by ill health in the larger and later part. Yet they were very different: the one in constant intercourse with his fellow men, the enthusiastic leader of a band of students, the centre of a society; the other compelled to lead a recluse life. They looked also upon nature from different standpoints. Agassiz was unable to accept Darwin's views as to the origin of species, though it is curious to see what concessions he was prepared to make in regard to a progression from an embryonic stage to one of high development. This, however, must be by successive creations, not by evolution. In regard to the latter he apparently shared the fears of not a few other religious men, and failed to see that the vision of Mother Carey in Peacepool, "making things make themselves," may be as full an expression of the operation of a Divine Mind as any scheme of creation.

Agassiz, though he had a hard struggle, was fortunate in many respects: in the possession of good parents, a vigorous frame, and a sound constitution; above all, in acquiring the friendship of such men as Cuvier and Humboldt at the age when their help was most needed. He was happy, like Darwin, in his family life, with a wife who was a helpmate, and a son who followed his footsteps, and still does honour to the name. Like Darwin also, he was *felix opportunitate vitæ et mortis*. Both had their obstacles to overcome, and their difficulties to conquer, but they would have found these more formidable, because more insidious, in the present generation. Is an Agassiz or a Darwin any longer a possible product?

Natural science is now sometimes in danger of becoming a department of literature or a branch of physics. These men went to nature for their teaching rather than to books: now they would find it hard to avoid being smothered with "the literature of the subject," and being choked with the dust of libraries. To read the life of the genuine lover of out-door nature such as Agassiz or Darwin, is like a breath from a glacier in the valley of the Rhone; to study the record of a life so simple, so earnest, so pure, so reverent, is a lesson for all time.

T. G. BONNEY.

OUR BOOK SHELF.

Beiträge zur Biologie und Anatomie der Lianen, im Besonderen der in Brasilien einheimischen Arten. Von Dr. H. Schenck. Zweiter Theil. Beiträge zur Anatomie der Lianen. 8vo. pp. 271, tt. 12. (Jena: Gustav Fischer, 1893.)

IN a brief notice of the first part of Dr. Schenck's "Beiträge" (NATURE, vol. xli., p. 514), the fact that it was only the first part was overlooked; hence the remark that all the plates of that part were devoted to the illustration of the external morphology of chiefly woody climbers loses the force it would have had, had it referred to the whole work. The second part has now appeared, and this treats of the anatomy, whilst the first treats of the biology of this class of plants. The two volumes form a valuable book of reference on this subject; and the illustrations include examples of the anatomy of the stems of climbing plants belonging to about twenty-five natural orders. There are twelve large folded plates containing 178 figures, all very laboriously and carefully drawn. The Sapindaceæ and Leguminosæ are most numerous represented, and present some highly curious structures.

W. B. H.

LETTERS TO THE EDITOR.

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The Late Solar Eclipse.

IN his account of the work of the Eclipse Expedition at Fundium Mr. Fowler seeks to explain his inability to obtain the photographs at the moment of totality by the assumption that he received the signal of the beginning of totality at least ten seconds too late, and he bases this assumption on his own estimate of the difference in time which elapsed between my signal and that of M. Coculesco, one of the French observers at Fundium.

I did not hear M. Coculesco's signal, as my head was necessarily enveloped in the dark cloth of my photometer at the moment, but M. Deslandres, the chief of the French party, with whom I returned to Europe, tells me that he estimated the interval at about two seconds, with which estimate M. Coculesco concurs.

There would seem to be good reason to believe that the actual time of the total phase was several seconds less than we had been led to expect. The chronometer observations at Fundium (lat. 14° 7') gave 243 seconds. M. Bigourdan, who was specially charged by the Bureau des Longitudes to make accurate observations on this point at Joal, which is a few miles to the west of Fundium, and in lat. 14° 9', informs me that the total phase there was 241 seconds.

It is possible, therefore, that Mr. Fowler's estimate of 10 seconds may not only have been erroneous in consequence of the known difficulty of accurately estimating a time interval